Oscillations of Coronal Structures Caused by Large-Amplitude Waves
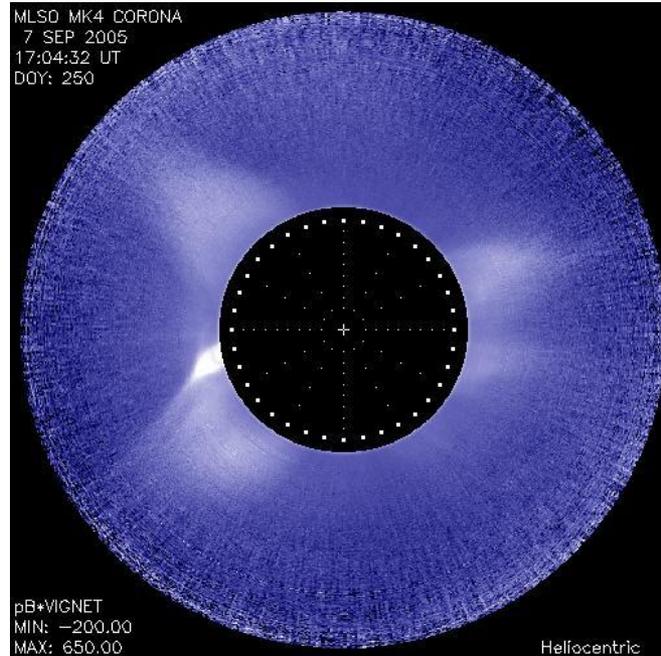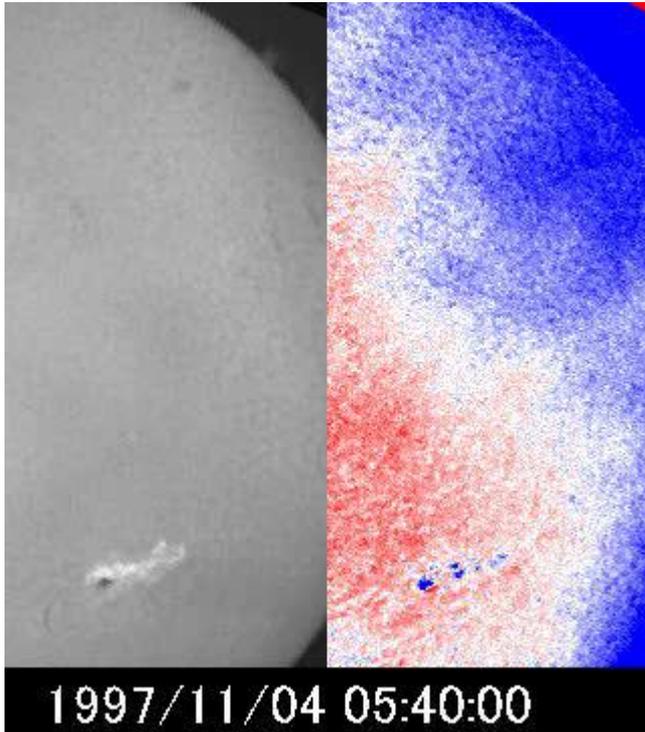
Bojan Vršnak, Tomislav Žic

Hvar Observatory, Croatia
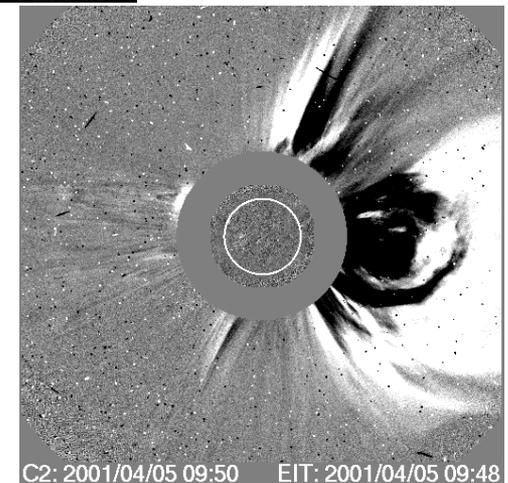
Wave -> Obstacle

1997/11/04 05:40:00

MLSO MK4 CORONA
7 SEP 2005
17:04:32 UT
DOY: 250

pB*VIGNET
MIN: −200.00
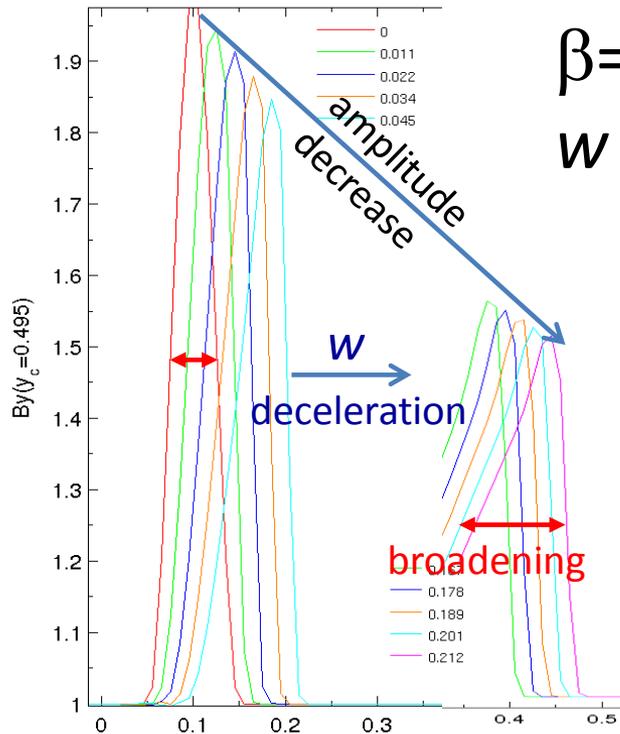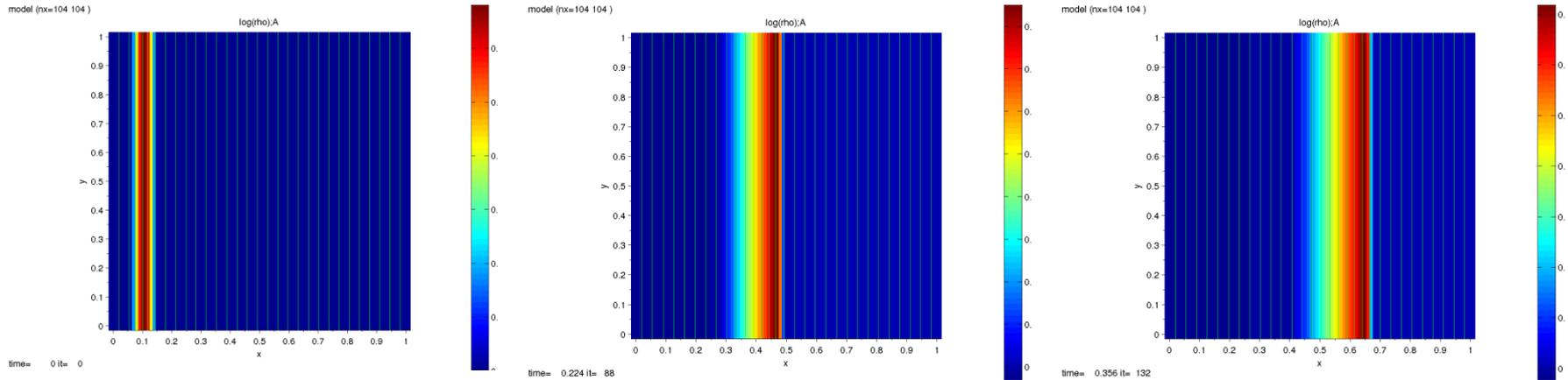MAX: 650.00

Heliocentric
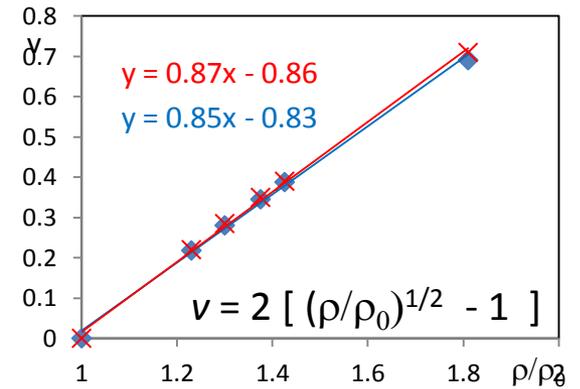

C2: 2001/04/05 09:50   EIT: 2001/04/05 09:48

- prominence oscillations ("winking filaments" Ramsey & Smith 1966)
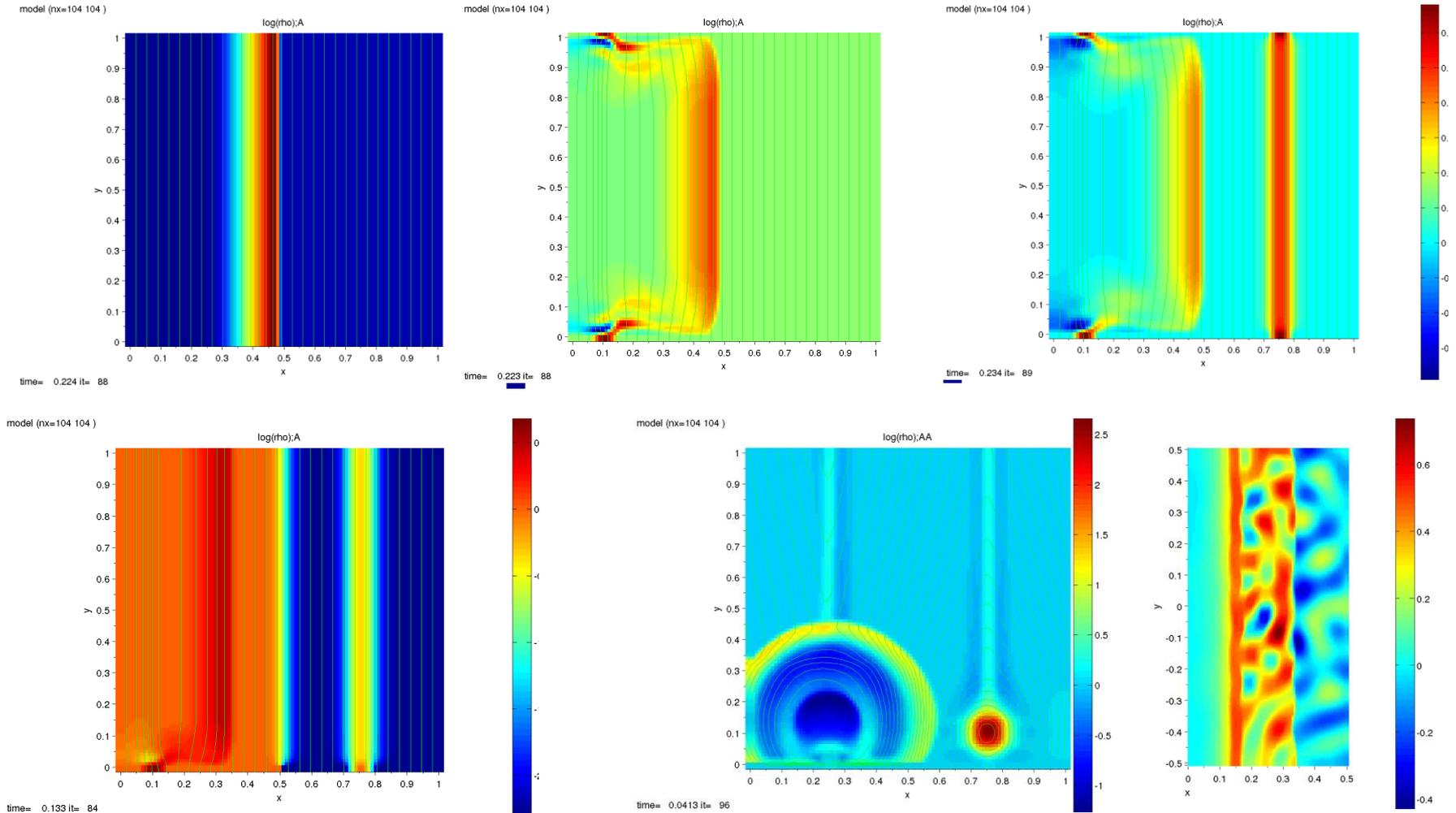- streamer displacements & oscillations

Perpendicular 1-D "Simple Wave"

$\beta = 0$:

$$w = v_{A0} + 3v/2$$

$$y = 0.87x - 0.86$$
$$y = 0.85x - 0.83$$

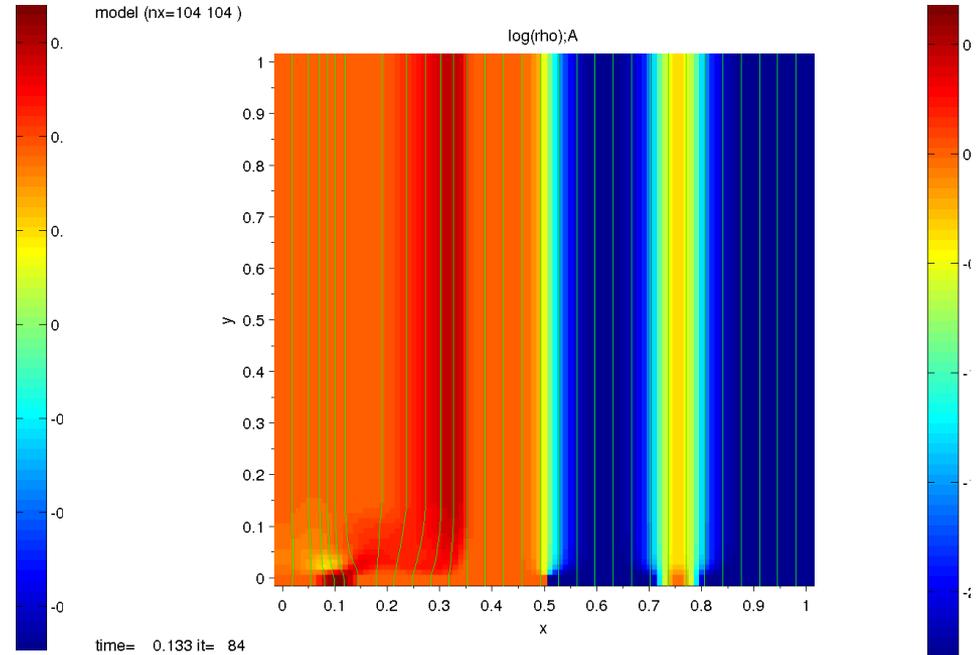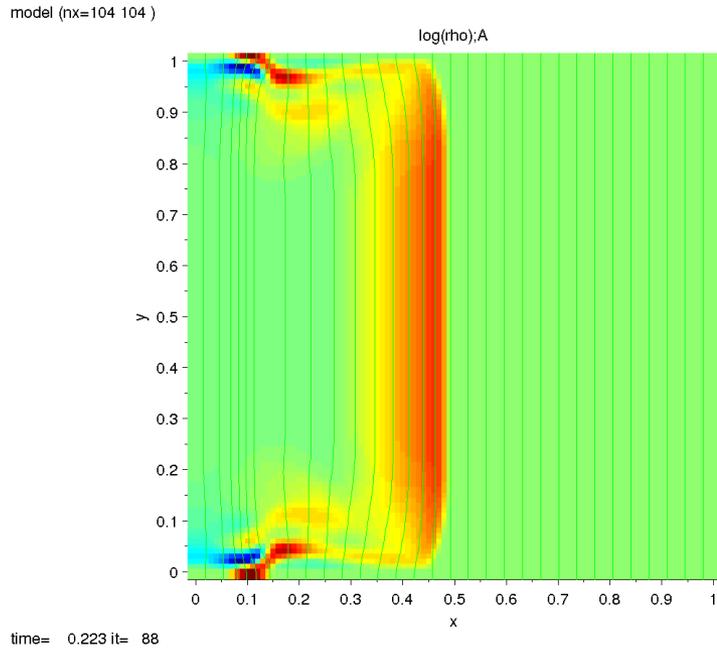$$v = 2\left[\,(\rho/\rho_0)^{1/2} - 1\,\right]$$

- amplitude decrease
- deceleration
- steepening of the frontal profile
- broadening

Perpendicular 1-D "Simple Wave"

- different boundary conditions; β = 0
- different ambient conditions and obstacles (1D, 1.5D, 2D, 2.5D)
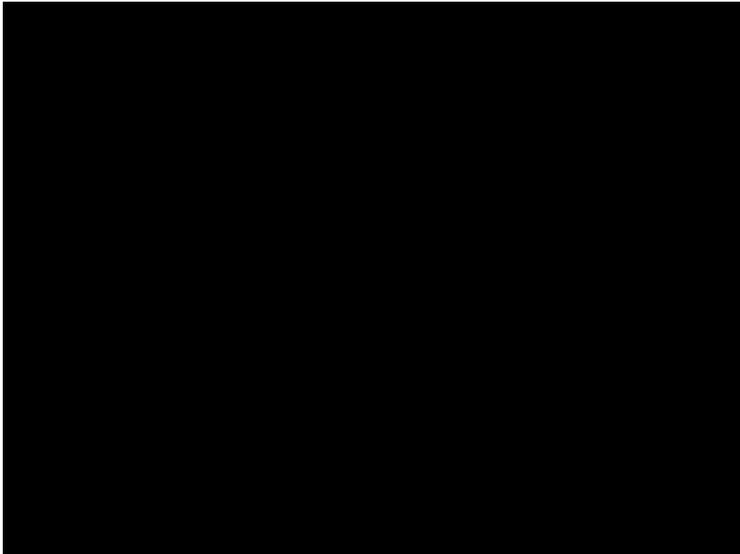
Effect of Line-tying

- lower amplitude
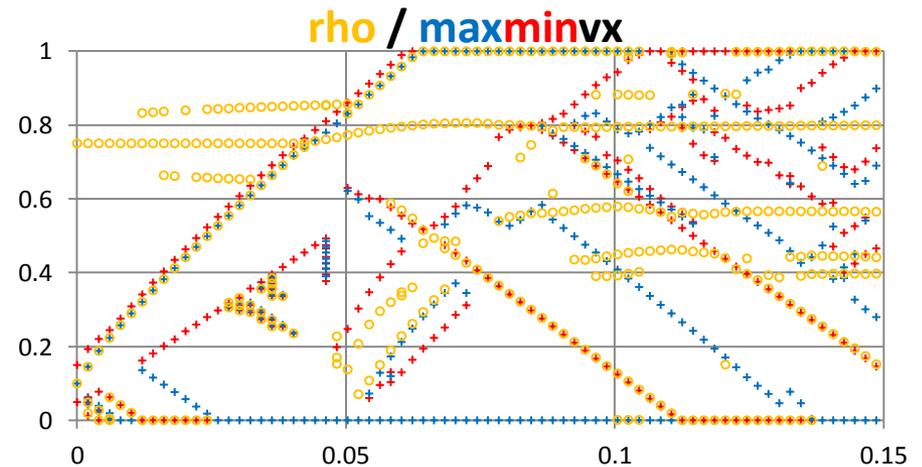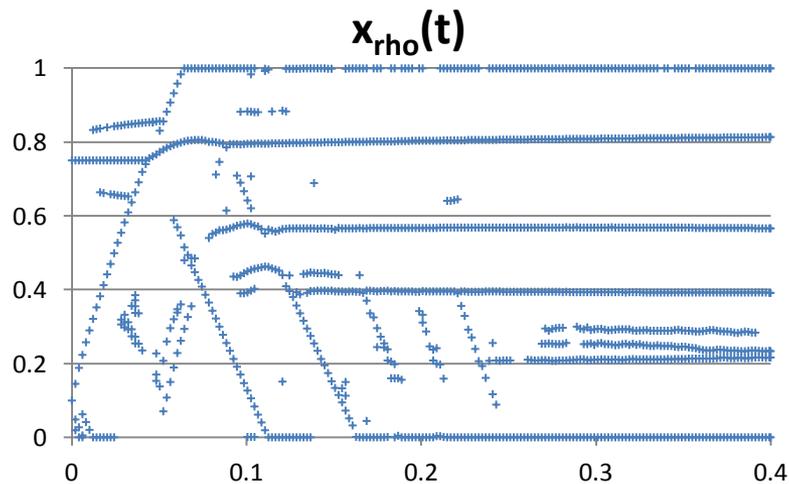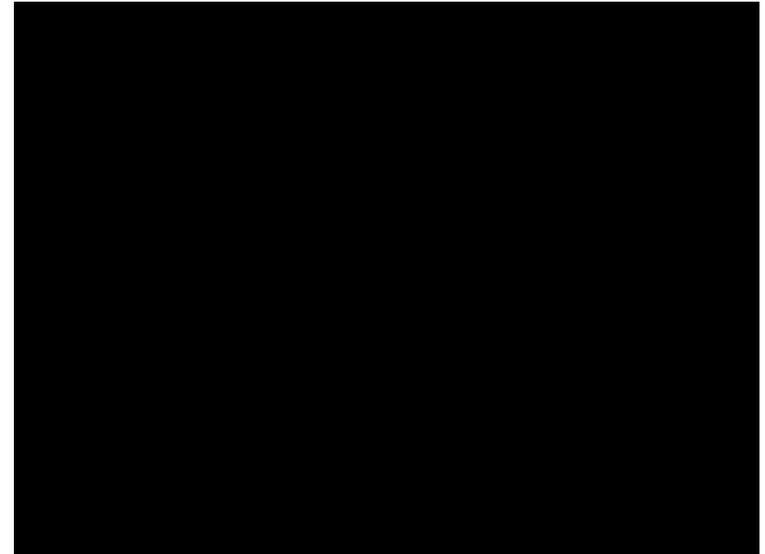- ambient m.f. relaxation
- formation of a trailing dip

Simple Wave –> Dense Obstacle
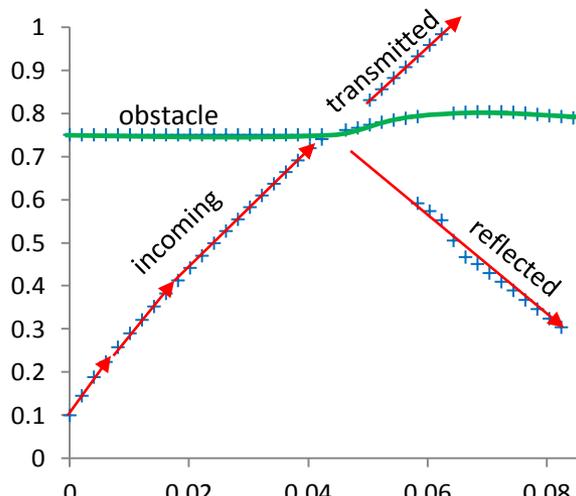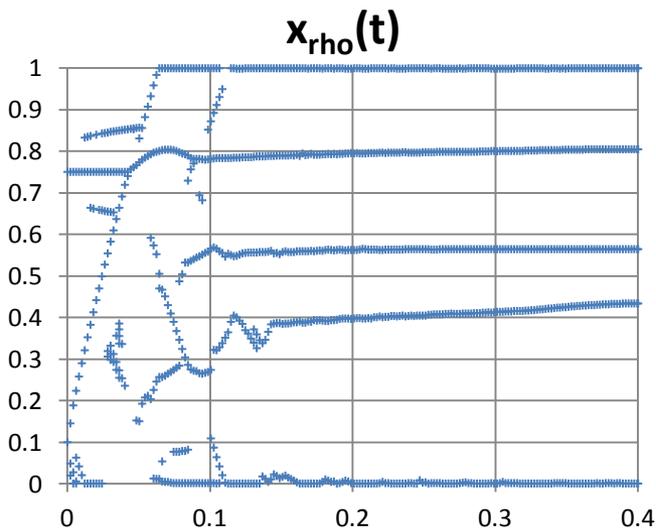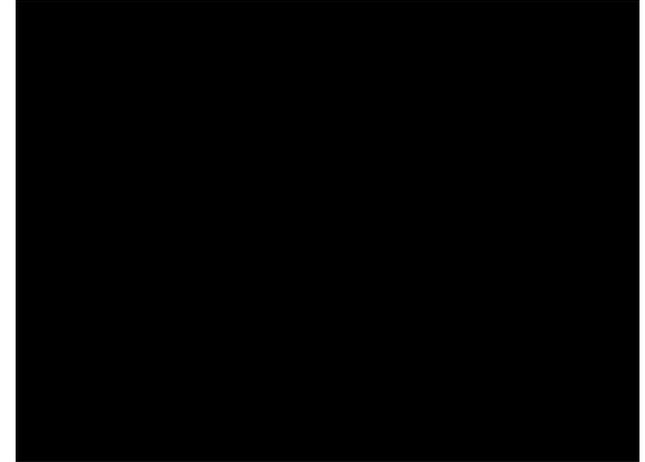## (prominence, streamer, pseudo-streamer)

free

fixed

$x_{rho}(t)$

rho / maxminvx

Simple Wave –> Dense Obstacle & Strong Drag

fixed

fixed

$x_{rho}(t)$

obstacle

transmitted

incoming

reflected
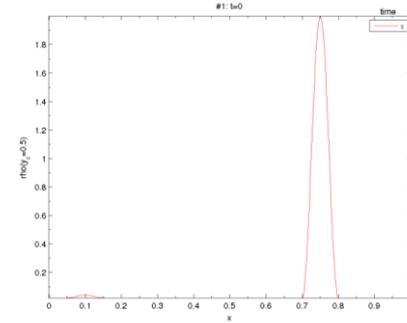

ff / **fc**
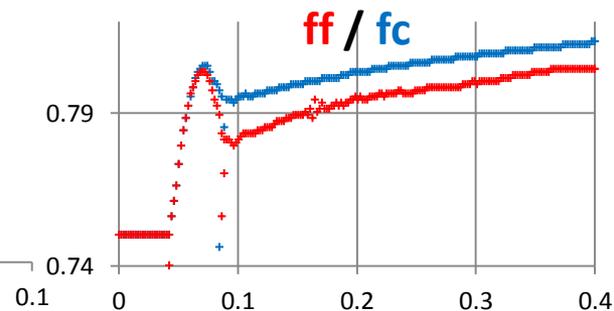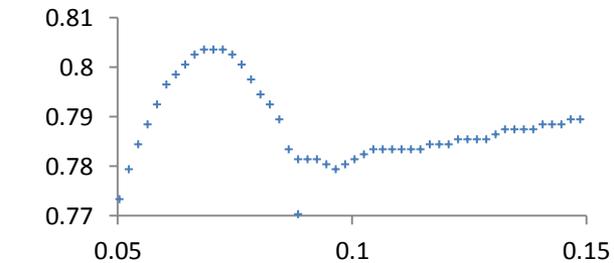
Simple Wave –> Dense Obstacle & Weak Drag
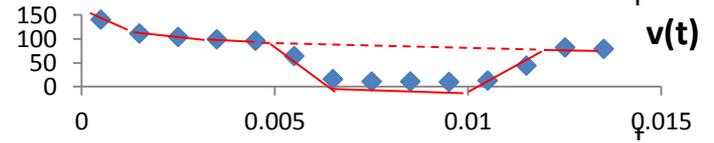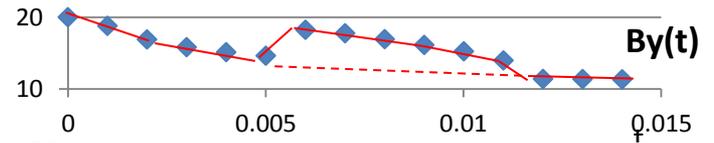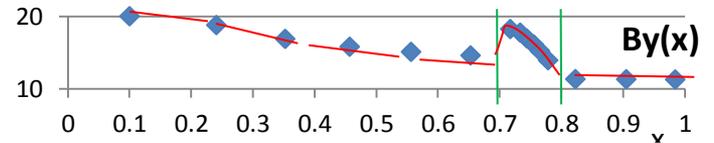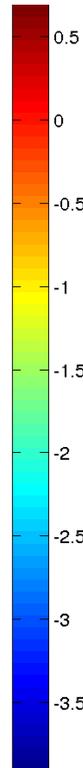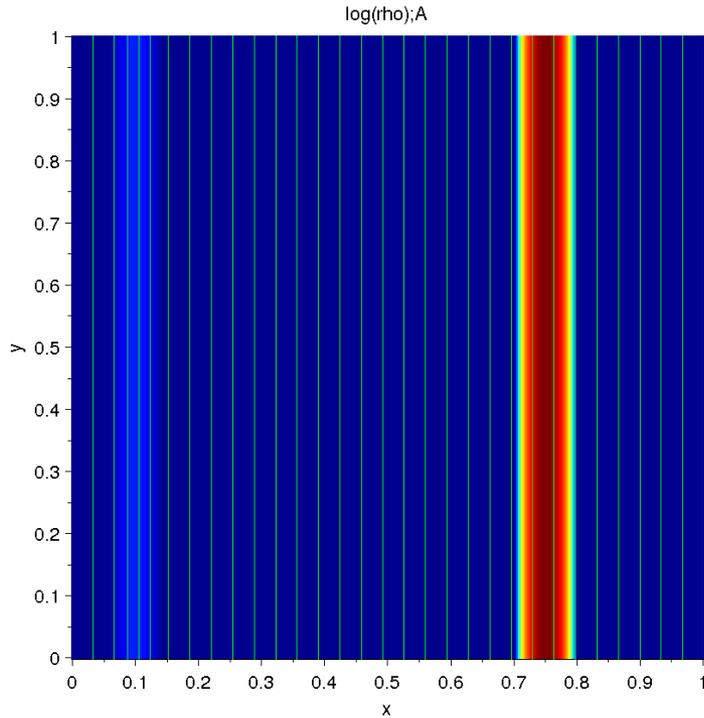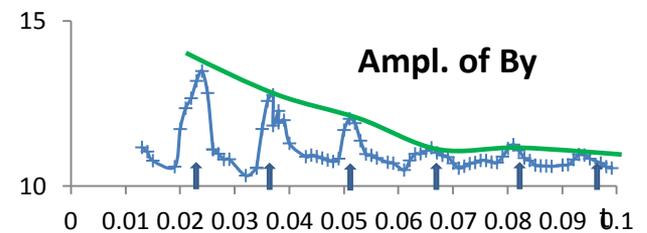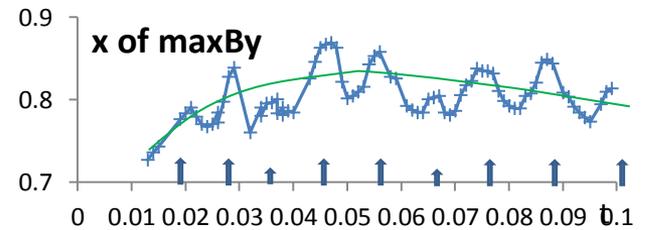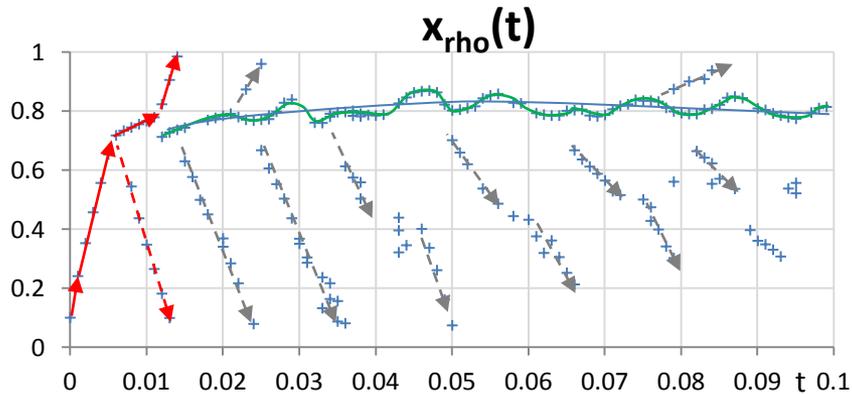
Analytical Model: Basic Modes

"kink" mode

$$\omega_0 = \omega_k$$

$$\omega_{k2} = \omega_k/2$$

$$\omega_{k3} = \omega_k/3$$

L

"sausage" mode

$$\omega_0 = \omega_s$$

D

$$\omega_{s2} = \omega_s/2$$

$$\omega_{s3} = \omega_s/3$$
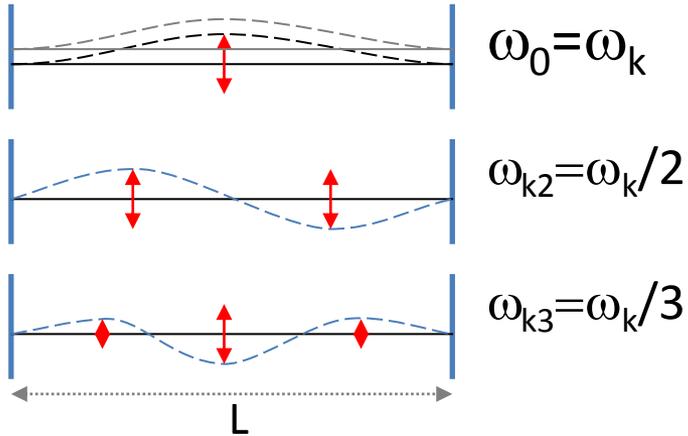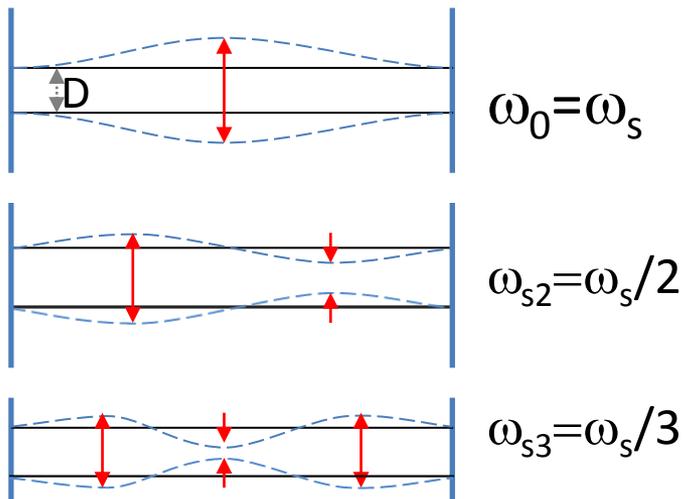
$$a(x,t) = -c_1 x + c_2 f(t) - c_3 v$$

$$[\ c_1 = \omega^2\ ;\ \ c_3 = 2\gamma\ ]$$

$$c_1 \sim B^2/\mu_0 \rho R \sim 2x B^2/\mu_0 \rho L^2$$

$$\omega_k \sim v_{A0}/L \quad \rightarrow \quad T_k \sim 2\pi L/v_{A0}$$

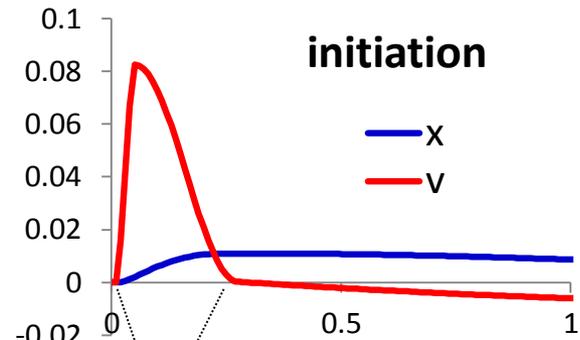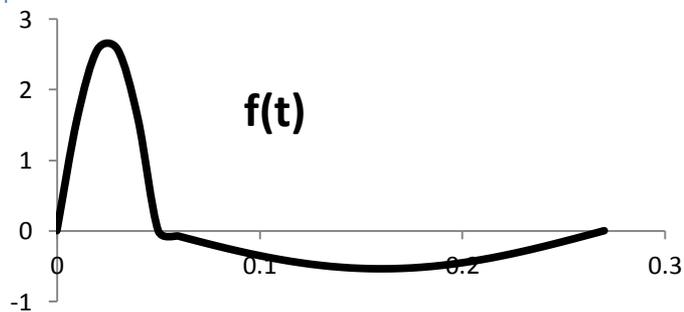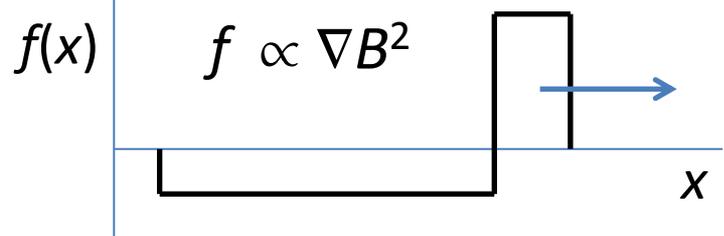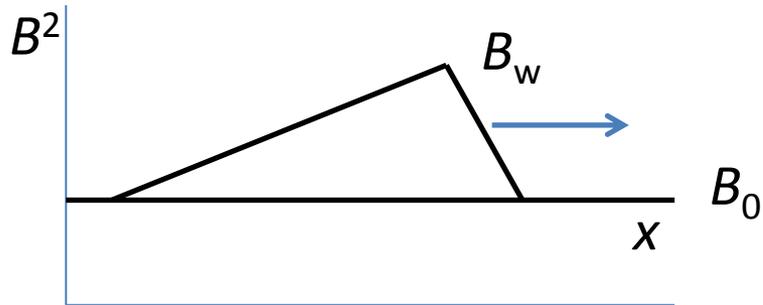Similarly: $T_s \sim 2\pi D/v_{A0}$

$$T_k/T_s \sim L/D$$

Analytical model: Oscillation Triggering
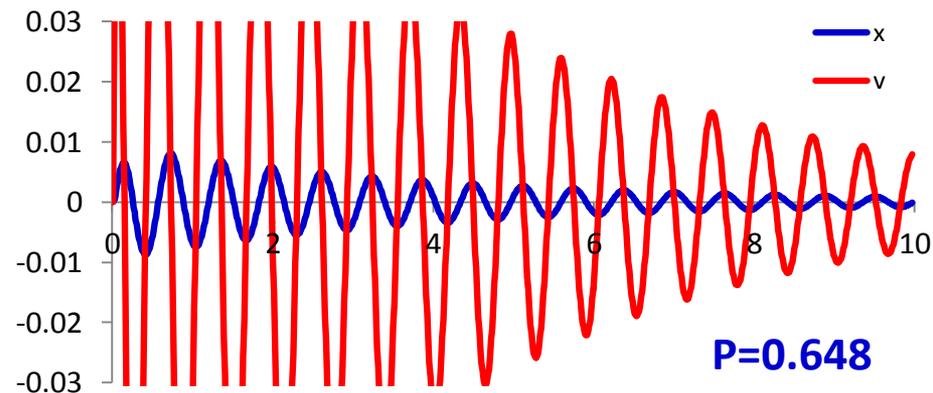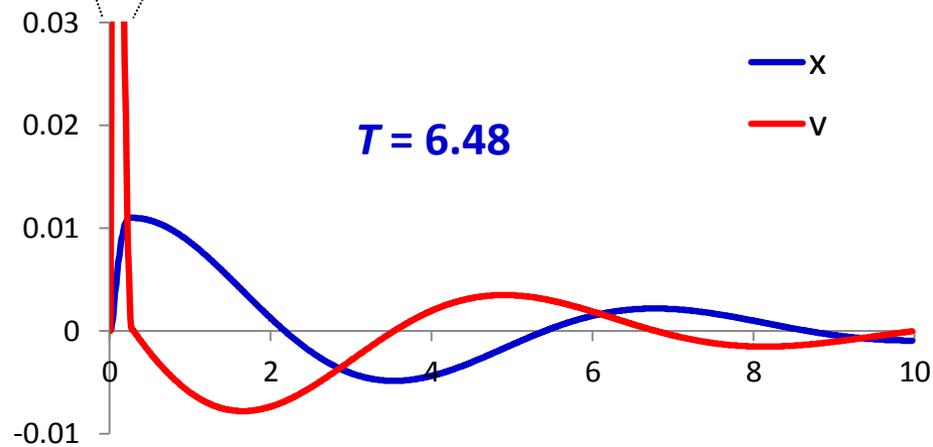
Simple Wave –> Low-Density Obstacle
(coronal hole, cavity)

Left plot labels: obstacle, transmitted, incoming, reflected, emitted by oscillation - 1, osci - 2, osci - 3, CH boundary

Right plot: rho, t, obstacle